INTERAGENCY

INSTRUCTIONS FOR RANGE SURVEYS

1937

F O R E W O R D

The purpose of these instructions is to outline the present policy for the conduct of range surveys and to standardize the methods used to the extent necessary to obtain the desired accuracy and uniformity in results.

Former instructions are herein revised to include modern procedure and acceptable new methods that have proved desirable and generally satisfactory. Promising new field practices are described in detail.

The instructions provide for the continued use of the reconnaissance method with minor changes, but also describe the so-called "square-foot density or point observation plot" method of determining density and composition, fully recognizing it as an acceptable and optional variation of the reconnaissance method.

Recognition of the square-foot density method for determining density necessitates a few other changes in procedure since that method measures density to as nearly as possible true ground cover whereas the reconnaissance method in actual practice results in much higher density estimates.

It may be generally assumed that these differences in density estimates are later compensated in final grazing capacity determinations by the use of proportionately different forage acre requirement standards. For this and similar reasons it becomes desirable in future projects to drop the "forage acre" as a common unit of measure, except as it is used in computation, and to summarize project results directly in terms of grazing capacity in future tabulations and graphic presentations.

It is recognized that each agency may wish to issue supplementary written instructions to its field officers, based upon the principles herein outlined, regarding methods not lending themselves to standardization or requiring the collections of specific data, not provided for in these instructions, in accordance with the unified procedure.

O B J E C T

There is an ever present need for the fullest and most accurate, up-to-date information practical to secure, in connection with the use and administration of the range and related resources for such purposes as livestock production, watershed protection, game conservation,

recreation, and other legitimate demands. The closest integration and coordination of these uses are essential if serious conflicts are to be avoided. As the demands for the various uses increase conflicts develop, the settlement of which requires accurate information regarding all the factors involved. It is for the purpose of obtaining these basic facts, analyzing the various problems and from them developing a comprehensive plan for managing the resource, that range surveys are conducted. A completed plan of range management should show what the range resource is, its physical condition, its relation to other resources, and how it may be best utilized, developed, and improved.

The collection of field data and the preparation of management plans, while essential, are of no greater importance than the training of the men who take part in the work. This activity is essentially field laboratory work in range management. It involves every phase of invoicing range resources, studying and analyzing problems, working out solutions, and providing for the application of thorough-going plans. In view of the recognized need for thoroughly trained range technicians and administrators, it is essential that training in the conduct of survey projects be stimulated in every way and adequately provided for.

RESPONSIBILITY

The instructions that follow are set up as minimum standards of requirement. Each agency may issue such additional instructions as they may find necessary in connection with specialized work or projects, provided, however, that such instructions do not alter the minimum requirements herein described or conflict with the principles herein approved. Each agency assumes full administrative responsibility for the adequacy and accuracy of the results obtained.

PRELIMINARY CONSIDERATIONS

Preparation for Field Work

Before the beginning of field work the responsible surveys man will obtain the necessary equipment and assemble and review all maps and other available data that will be needed, including the following:

1. Sufficient number of sets of topographic maps preferably on a scale of 2 inches to the mile, or serial contact prints. Aerial photographic maps are preferable when obtainable. If aerial maps cannot be procured and the available base map is not on the desired scale, photographic enlargements or reductions may be made. Unmounted copies may be used by the examiners for typing in the field. Where maps of satisfactory accuracy are not available, accurate field maps on a 1- or 2-inch scale must be prepared, either prior to or in connection with the range survey work. Minimum control requirements as described on page 4 must be followed in connection with the field mapping and typing work.

2. Status of land. Where covered by G.L.O. surveys, proper township assemblage of Land Office surveys for the area to be covered.

3. Location of known section corners and of as many as possible of such cultural features as buildings, fences, corrals, roads, trails, driveways, improved water developments, telephone lines, etc., including locations by special surveys.

4. Names and class of range users, numbers and kinds of stock grazed, and allotments or units used.

5. Table of forage palatability ratings for each kind of stock and all important forage plants, expressed in percentages. Agencies working in the same general localities should jointly develop and agree on the palatability ratings used.

6. In connection with the correlation of grazing and other uses of forested lands, the following information and data should also be obtained to the extent that it is available:

A. Under timber use, the cut-over lands, lands being cut, and lands proposed to be cut within 5 years, planted areas and proposed plantations, as well as a timber type map for field use if available.

B. The value of each watershed, as for municipal water supply, irrigation, or power; and areas closed to grazing or on which grazing is restricted for the purpose of watershed protections.

C. Population estimates of important big game species; approximate range; seasonal use of areas; areas of introduced game; plans for handling, developing and utilizing; boundaries of refuges, present and proposed; and any restrictions on grazing to provide for game. In addition careful notes should be made of the occurrence of smaller fur-bearing animals, upland bird species, etc., and of the means by which grazing can be better correlated with the management and protection of these forms of wildlife.

D. The general recreation plans, public camping grounds, summer home sites, and other recreational features which might have a bearing on future grazing plans.

E. On forested lands where fire protection is unusually important, it may be advisable to determine the areas of greatest fire hazard, general fire-trail plans, and possibly the fire-control plan.

F. Data regarding any areas used for experimental purposes.

The above data will be secured from administrative records or from any other reliable source. As much of the data as possible should be entered on maps for reference in the field.

Before the party goes into the field, the chief of party should familiarize himself with the area to be covered, in order that he may be able, upon consultation with his superior officers, to decide upon the place to start work, the route for covering the area, the location of camp sites, general conditions, and general phases of present management.

Fire Season

Within practical limits the survey should not begin until the season is sufficiently advanced that there will be a representative growth of forage on the ground. The work should continue in the fall until grazing or weather conditions prevent accurate classification.

Control for Range Classification

Base Map: A reliable base map is essential. Aerial photographs or recent U. S. Geological Survey topographic maps are preferable. Timber survey maps or those prepared by other organizations may serve as a base where they conform to satisfactory accuracy standards.

Control: In connection with the accurate mapping of vegetation types, it is necessary to have definitely located points on the area being covered in order to properly tie in the work. Every three sections and preferably every two, should have an accurate tie point. If satisfactory Land Office surveys have not been obliterated, they will serve admirably, provided they have been reconciled to the primary control and the topographic map. This reconciliation and the establishment of control where necessary should be done by personnel fully qualified for technical work of that nature. The project man responsible will decide upon the adequacy of or additional control needed in each case.

Where mapping or typing is done by triangulation, using U.S.G.S. or C. & G. S. primary control, it is essential to correlate the triangulation control with G.L.O. corners at a frequency of one to three corners per township. Approximately nine secondary control points in each township should be accurately located and marked. A minimum of five secondary control points per township is considered essential for intensive work. When recent G.L.O. surveys are being used for control in mapping and typing, the minimum tie requirement should be one corner per section.

PROCEDURE IN THE FIELD

General Statement

It is impracticable to set up one arbitrary standard to which the field work in every project should conform. The general character of

information obtained should not vary materially as between projects - it should be consistently accurate and reliable, but the intensity of the field examination and the amount of detail in the data may vary according to the importance and complexity of the grazing and related problems. The Chief of Party or responsible project man will decide when the proficiency of the men has reached a point that will assure the examination work being carried on in accordance with minimum standards of requirement set up.

Size, Organization, and Qualifications of Party

Experience has shown that under national forest conditions a party made up of a chief, three or four temporary or permanent assistants, and one combination cook and camp mover constitutes the most efficient, economical, and practical organization where the field work is done intensively. A larger party requires too frequent moving of camp and too much camp equipment. On the other hand, a crew of less than four field men cannot be handled with much less outlay for cook and moving equipment than is required for a party of four or five men. When aerial photographic maps are used, whereby the detailed typing work is materially speeded up in the field, smaller crews and horseback work may prove more satisfactory. In level or undulating country many agencies find the use of a car saves much valuable time in traveling between sampling plots or reaching advantageous starting points. The accessibility of the country to be covered, the number of qualified men available, etc., should be considered in determining the size and make-up of the crew.

Individual examiners not working under the direction of a chief of party should have sufficient training under a qualified man as to enable them to carry on the examination work in accordance with the standards herein provided for.

Chief of Party

Where projects are conducted on a party basis, the importance of selecting the best qualified man available to serve as chief of party deserves repeated emphasis. The uniformity and quality of the party work often importantly depends upon his judgment and training ability. The position is looked upon as important enough to justify using men up to the $3200 grade where qualified men in that grade are obtainable.

The chief of party should be a man of good judgment, thoroughly trained in the technical work, and with considerable administrative experience. He must be able to handle and direct his men and cooperate with local officers and stockmen. He should be experienced in range survey work on the ground, and will be expected to lay out the work of the men in the field, see that the project plan and field methods are thoroughly understood and followed by the men, train them to observe and analyze conditions, take measures to secure uniform results, exercise discipline, keep the data in proper form so that if necessary it may be

turned over in understandable shape to a successor, order supplies when good business so directs, and maintain a check on expenditures. He should make a thorough study of range conditions, utilization, and management needs on the area as a whole, in order to be able to participate in the preparation of a comprehensive management plan at the completion of the project. At the close of the field season he should direct and aid in the assemblage and compilation of all data for the management plan and help prepare the final plans for the range unit, or parts of the unit covered.

Other Members of Party

Men with a natural inclination toward the work, with suitable training or experience, and with promise of developing so as to assume greater responsibility in the future, will be selected for the regular party work or chosen as temporary assistants. Because of the strenuous character of the work, especially when done on foot, men must be in good physical condition.

Either technical or non-technical administrative men already in the agency will be encouraged to serve on the party for one or more years where such assignments are considered in the best interests of the work and the men.

By every means possible the whole party should be given insight into the broader phases of the work, its purpose, and the use of results. This is of utmost importance in arousing a personal interest, which is essential to a high degree of accuracy and efficiency. When interested students or other promising field men are obtained under local emergency employment programs for this type of work, the need for greatly increased field and office supervision becomes increasingly important and may involve the necessity of providing one or more assistants to the chief of party in order to maintain the work standards. If any members of the party do not take a proper interest in the work, it is advisable that they be replaced by men who will.

The cook and teamster-packer fills a position of no mean importance in the field party. On him depends to a large extent the welfare and morale of the other members of the crew. He should be able to do good plain cooking in a sanitary and economical way, be willing to serve meals at whatever time the men get into camp, and possess an agreeable disposition. He should assume charge and take care of all equipment in camp during the absence of the other men. He should know how to handle horses and take over the responsibility of their care. If conditions justify a separate teamster or packer, he should be chosen because of his proficiency in such duties and his familiarity with the region.

FIELD METHODS

In order that new men may early in the work gain a definite conception of the use to be made of the various data collected, all the steps connected with the field work and the preparation of a complete

management plan should be covered for a sample unit. For this purpose a suitable allotment should be selected as soon as the men become familiar with the mechanics of the field work.

Typing and note-taking in the field will be done ordinarily by each man working individually. The chief of party will designate the units or areas to be covered by each examiner from each camp.

Legal subdivision or ownership will be used as the unit for the correlation of notes and type descriptions except in cases of large blocks of land under one jurisdiction where the topographic unit would be more satisfactory.

In the rough country, consideration should always be given to the topographic unit in deciding the area to be assigned each examiner so that there will be no undue crossing of steep canyons or high ridges in covering the area unless the type classifications would suffer through the adoption of such a course.

Typing and Mapping in the Field

The intensity with which types should be examined will vary considerably. The minimum requirement is that the examiner should see enough of each type to obtain a reliable estimate of its density and composition and to determine the various conditions that would affect the practical use of the type. Where previously compiled type maps or aerial photos are used, each day's work should be so planned that the examiner will pass through the largest portion of each type without back-tracking or recrossing the general line of travel.

Where topograhic maps are used, and if the types are governed, largely by topography, the types and other data can be located and mapped with reference to topographic features or by pacing a sufficient distance from known points to make the work reliable.

Where the planetable method of mapping is employed types are accurately mapped by point intersection and the forage estimates are made by going through representative portions of each type while traveling between vantage points or control stations. Each type or sub-type must be examined but type boundaries are located in connection with the mapping work.

Very much the same principle applies to the use of aerial maps or photos. Where these are used, type and sub-type boundaries will be indicated by the examiner. Care must be taken that each type and sub-type is satisfactorily examined and given a key number or other symbol to provide a reference from the photo to the write-up sheet.

Where the "strip" system is used, the examiner will cross the area in a systematic manner by compass and pacing from established points, with checks on as many points as it is possible and practicable to make.

On areas surveyed by the G.L.O., section and quarter corners will be used as control points, and section lines and centers of sections will generally be followed. If there are no Land Office surveys, or if survey corners have been largely destroyed, other control points, either those located expressly for this purpose or monuments left from earlier topographic mapping, will be necessary. The areas should be covered on a basis equivalent to passing twice through each section and mapping at least 20 chains on each side of the line traversed, with sufficient offsets to obtain the necessary information for all the types, and properly map their boundaries.

Where the types are large and uniform, crossing the area the equivalent of once through each section may be sufficient. The chief of party or responsible examiner will decide when a basis of less than twice through a section is sufficient to maintain the required standards of results. In very rugged or barren country, or where the forest cover is too dense to permit grazing, the types need examination only to the extent necessary to be assured that no usable feed areas are overlooked.

On special projects requiring greater or lesser intensity of examination, the intensity standard to be used should be clearly specified by the responsible administrative agency in issuing supplemental instructions applicable to the specific project.

The following data should be obtained by the examiner and shown on his field map.

Forage Types. The area should be classified into types and subtypes and mapped in accordance with the outline given under the section on "Classification of Forage Types." Typing of areas of less than 10 acres may be desirable at the discretion of the agency conducting the project. Such important areas as parks in dense timber, clumps of timber in parks, and other similar type changes down to 10 acres in size, if they are important landmarks may be mapped. Ordinarily, unless some marked contrast of this character exists, or specific instructions given, a change in type of less than 20 acres need not be mapped. Special attention must be paid to the mapping of inaccessible areas which come under Type 7. Areas which are inaccessible because of lack of development, lack of water, steepness, etc., should not be mapped as Type 7, but they should be typed and their degree of inaccessibility noted on the write-up sheet and map as a utilization cut. If definite determination as to accessibility cannot be made by the examiner, a note should be made of the areas, and the case should be referred to the chief of party for final decision. Types should be designated by number on the map. At the discretion of the agency, the density and composition of all plants used by game should be recorded in such form as may be compiled when needed for game management plans.

Soil Erosion. Because of a depletion of native vegetation, accelerated erosion has attained such importance on range lands that it is necessary to take it into account in range management. It is equally

evident that the character of the soil and the degree of slope are important considerations from the standpoint of range management and improvement.

A summary of erosion conditions will be written for each management unit, recognizing the general erosional, slope and soil conditions.

Topography. The topographic map should be checked in the field during the course of the work. All topographic features which have local names should have such names included on the map or aerial photos whenever possible to do so.

Drainage and Watering Places. All drainage lines and watering places should be shown. Special attention should be given to the mapping of water facilities for stock, as they often are a controlling factor in range management. The examiner should check all the water on the original map and add the minor watering places which usually are omitted. On aerial photos it is important that running water in small streams be shown and the limits of such streams indicated.

Culture. Buildings, fences, corrals, roads, trails, telephone lines, and other cultural features should be located, and those already shown on the map should be checked for location. Fences, where they are important to range management, should be accurately located. On aerial photos such features should be inked in with India ink. The standard symbols as adopted by the board of surveys and maps of the United States and published by the U.S.G.S. should be adhered to for range survey work so far as symbols are available. When additional symbols are needed it is recommended that all agencies make an effort to get them standardized and approved by the board of surveys.

Alienated Lands. Time need not be spent in the field in accurately checking the boundaries of lands shown in the status record, as it is assumed that the survey of such lands is correct. If private lands are or may be used in connection with the range unit they should be gone over and classified as a part of that unit.

Field Notes. Each type and sub-type will be written up on Form 764a or 764b in the manner called for thereon. (Sample forms attached)

Unit descriptions. Each examiner should summarize the important management features for each section, ownership tract or other unit if such a system is called for by the particular survey. It will be noted that many points are duplicated under the information to be gathered by the chief of party, however, it will be standard practice for individual examiners to cover all of the following subjects for each subdivision or natural topographic unit as a check for the chief of party on the information collected by him personally. On special projects this procedure may be modified so that it will be obtained as accurately and expeditiously as possible without undue duplication.

1. Elevation, topography, and drainage as these affect the accessibility of range to stock; drainage systems whether flat, rolling, or rugged; depth of canyons, steepness of slope, rock exposures, slides, boulders, cliffs, general accessibility.

2. Character of watering places (stream, lake, pond, spring, seep, well, tank, reservoir). Permanent or temporary (if temporary state usable period). State of development and need for improvement or maintenance; nearest permanent water; character of country, particularly the slopes; relative amount of water available as compared to carrying capacity of the range.

3. Number of stock now using the range, either estimated or known, current utilization, condition of the range and the forage, with recommendations for proper numbers of stock on basis of past use and condition.

4. Kind of stock now using the range and recommended kind based on above factors.

5. Proper seasonal use. Present date when stock enter or reach each portion of the range. Recommendation for changes within the limits of practicability, and based on the needs of the forage, when forage or water is available, etc.

6. Proper distribution of stock. Over or under-grazed areas, with recommendations for improved handling.

7. Handling of stock. The manner in which stock is being handled, including herding of cattle or sheep, bedding of sheep, conditions of bedgrounds, excessive trailing and other phases of management with recommendations of needed changes and reasons therefor.

8. Recommendations for needed changes in present salting and reasons therefor.

9. Range destroying rodents, species, location, area and damage.

10. Poisonous plants. Species, abundance, area and location, losses, and recommendations for methods of avoiding future loss.

11. Other pests such as grasshoppers, crickets, etc. Estimated damage.

12. Game. Indications of game on the area, seasonal use by game and other important matters relating to game welfare.

13. Predatory animals. Important species, approximate ranges, depredations.

14. Extent to which other uses enter into or conflict with the use of the area and adjustments to be made. Timber production, watershed and soil protection, recreation or any other legitimate demands.

15. Range improvements needed; water development, division or boundary fences, corrals, bridges, trails, driveways, reseeding and deferred grazing areas; others.

PALATABILITY

Palatability, as used in range surveys, is the percent of the total current year's growth, within reach of stock, to which a species is grazed when the range unit is properly utilized under the best practical range management. The class of stock, the composition of the vegetation, and the proper time of using the range as a whole, etc., must be considered when rating the palatability of individual species. This percentage should not be in excess of what may be grazed under proper use and still allow the plant to maintain its stand and vigor, year after year. As a basis for individual palatability figures, a palatability list should be prepared cooperatively where local associations are organized, by all the agencies concerned for each major vegetation region or smaller ecologic unit if desired. The ratings may be revised, if necessary, to fit local conditions or needs, upon recommendation of any agency, if agreed to by the local inter-agency committee.

It is very important that members of the survey party learn the relative palatability of the principal range plant. Plants are eaten more readily under certain conditions than under others. Affecting palatability are such conditions as the combinations in which plants occur in the type, intensity of grazing, season in which they are grazed, mechanical features (awns, etc.), and, to some extent, the familiarity of the stock with the classes of vegetation. The palatability estimate must take all these factors into consideration and be based on the proper degree of utilization under the best practicable management.

DENSITY AND COMPOSITION

Reconnaissance Method

Density

In estimating density the spread of the vegetation above the ground must be carefully considered. The density of more or less upright weeds should be based on the amount of ground that appears covered when the vegetation is viewed from directly above. In estimating the density of spreading weeds or browse or open clumps of grass this forage should be pressed together or raised at an angle so that all of the normal interstices between the leaves are completely filled without compressing or unduly crowding the vegetation. The forage is then so compacted that it will represent a 10/10 density. All density should be judged on the basis of growth during a

normal year. The density of browse should be determined by the portion of the ground covered by that part of the browse that is accessible to stock. This may exclude from the estimate the interior of dense clumps. Any oak or other brush that forms an upper story beyond the reach of stock does not enter into the density estimate. Where a double story of available vegetation exists, such as browse over grass, judge the density of each story separately. Both stories are included in the density estimates. Care must be exercised that the density estimate represents a true average for the type as a whole. Especially is this important in composite types which cannot be divided into separate types.

In passing through the type the examiner will mentally calculate and carry with him a moving average of plant density and composition. In large types the examiner should jot down notes on density and composition changes in order to better analyze type averages and aid his mental calculations.

Composition:

Type composition estimates are based on the relative density abundance of each available vegetation species in the type. The examiner should not write up his type until he has seen a fair sample of the total type area. Preferably he should complete his write-up while still in a representative part of the type. Type composition is itemized on Form 764a expressed in terms of percentage. The sum of the percentage ratings for individual species should always total 100%. In determining composition the examiner should rate each species in accordance with his best judgment as to its individual abundance with relation to the total cover.

In the interests of obtaining uniformity between examiners it is generally desirable to estimate composition by rating the species in accordance with their relative abundance in the type, starting with the most abundant species and rating each lesser species in turn. Such a rating scheme results in a definite expression of relative abundance. Afterward the individual initial ratings may all be slightly adjusted to total 100% without destroying the established ratio.

Field Computation

After the composition rating for each individual species has been recorded, that rating is multiplied by the accepted palatability rating for the species, and the sum of all the individual products yields the weighted average palatability of the type. This last figure multiplied by the estimated density yields the forage factor or palatable density of the type. The forage factor is carried onto the camp map for type "jibing" purposes and otherwise used in compilation of the data but should no longer be placed on the final map or used in grazing capacity summaries.

Square Foot Density Method

Definition of Method:

The square foot density method is a system of sampling vegetation by randomized and replicated plots. It differs from the reconnaissance method in the manner of estimating density and of obtaining average species composition and density on plant types of varying acreage. The procedure for computing grazing capacity following the determination of the forage factor is identical for the two methods.

Procedure:

How to lay out a plot: The plot used in this method is a circle 100 square feet in area, with a radius of 5.64 feet (or 5 feet 7.8 inches). Two systems of describing the boundary of this circle have been found to be most convenient:

1. Compass system.- Two stakes connected by a light chain equal to the radius (5.64') of the circle constitute the apparatus. In laying out the plot one stake is struck in the center of the sample plot and the other stake is used as a compass to circumscribe the plot. Care must be exercised to keep both stakes erect and the chain tight and horizontal.

2. Radius rod system.- The apparatus consists of a stick equal to the radius (5.64') of the circle. By holding one end of the rod at the center of the plot, and using the other end as a marker, the boundary of the circular plot may be scratched in the soil. In marking out the circle, hold the rod horizontal, close to the ground and scratch short segments at intervals to indicate the plot boundary.

Care must be exercised in marking the plot boundary. For example, a 6-inch mistake on the radius of a 100 sq. ft. circle introduces an error of 13.4 sq. feet in the area of the circle. Any method of describing the circle accurately and quickly is acceptable and should be left largely to the discretion of the estimator as influenced by the character of the vegetation to be sampled.

How to estimate density: In the square foot method the density of each species occurring on a particular plot is estimated individually. No attempt is made to estimate the percentage each species comprises of the total plot density.

A square foot of ground completely covered by vegetation when viewed from above is the standard for estimation of density. The vegetation is never viewed obliquely because this tends to increase the estimate by allowing plant height to hide the ground surface. It is essential that the estimator have a clear conception of a square foot area in his mind and that he constantly refresh his memory by means of a wire frame one foot square, divided into quarters, which he should carry at all times.

In estimating weeds or grasses, if the herbage is spreading or prostrate, it should mentally be compacted so that all the normal interstices are completely filled without compressing or unduly crowding the vegetation. Density of upright weeds or grass should be based on the amount of ground that appears covered when the vegetation is viewed from directly above. Density estimates of shrubby species should consist only of the current year's twig growth and the leafage present on the plant; trunks, or heavy branches being excluded. In estimating for different classes of livestock, shrubby material within 30 inches from the ground should be taken as available for sheep and within 60 inches for cattle. Any vegetation unavailable to livestock owing to height or to other factors should be excluded from the density estimate.

Density for each species should be based on the appearance of the plants when they have attained their full normal growth. In other words the plants should mentally be reconstructed to compensate for one or all of the following conditions; (1) for growth still to be attained; (2) for portions already eaten; and (3) for abnormal total forage production.

In considering a double story of vegetation the density of each layer should be estimated.

Using the square foot as a unit of measure with the foregoing principles in mind, mentally amass individual plants of a species into square-foot units of total density and do this progressively until the total number of square-foot units of that species has been counted for the plot. As an aid to counting square foot, the unit of estimation may be 1/4, 1/2, or 1 square foot depending on the density, abundance and growth character of the species. This procedure should be continued by species.

The number of square feet of 10/10 density recorded for a given species represents the percentage of total ground area covered by that species because a square foot is one percent of the total plot area.

Individuals should check their density concept at least once a day by picking the plants on a plot and placing them within the wire frame or on a square foot area that has been marked out on the ground. Plants should be so placed within the square-foot area that they constitute a 10/10 density without crushing plant parts together. This check preferably should be made by all members of the field party on the same plots to afford uniformity of results and also to evaluate the personal error of estimate. Each new species should be checked when encountered. The accuracy of this method depends to a great extent on the density estimate. Therefore, utmost care is essential in making this simple measurement.

How to record estimates.

1. On the form to be used for recording density estimates, list all species occurring in density on the plot, either by name or by standard

plant symbol. Species should be listed by the three common vegetative groups: grasses, weeds, and browse.

2. Density of species should be recorded directly in square foot or fractions thereof.

3. Before leaving each plot, make an estimate of total density and check the sum of the species estimates to see that it equals the total density of the plot. This is necessary to avoid the omission of important species.

4. All plots within a particular type or sub-type should be recorded on the same sheet or sheets. No plots in other types should be included. If the survey is by land lines set up a new set of sheets for each section. In any case, whether the survey is by land lines, topographic units or types it is essential to record on each and every sheet (1) the section, township and range or reference to aerial photograph where these are used in lieu of a base map; (2) examiner's name; (3) date; (4) plot numbers; (5) type and sub-type; (6) number of the plot series (transect or type number).

5. Locate each plot of a series or transect within each type by a dot on the field map. In every case show route of travel by progressive plot numbers or directional arrow. Also identify each transect on the map by its number.

Field Application

The square foot method is based on the premise that average values obtained from several definitely defined and impersonally selected small plots is more accurate, uniform, and representative of the type to be sampled than is a general opinion formulated in the estimator's mind as he walks through the type. By varying the procedure in sampling, increasing or decreasing the number of plots, or by a combination of the two, the method is sufficiently flexible to meet all ordinary field conditions.

Six general conditions may be encountered in the field. These are: (1) a mixture of small vegetative types and sub-types with widely different grazing capacities; (2) a mixture of large types; (3) a mixture of small type with similar grazing capacities; (4) one or more large types with high grazing capacity, interspersed with small types of low grazing capacity; (5) a single, large, homogenous type, and (6) a mixture of large types relatively low in grazing capacity, interspersed with small distinct types of high grazing capacity. The procedure in sampling these conditions should be varied to obtain uniformly dependable data most economically.

Three variations in sampling procedure are: (A) sampling within types (B) stripping or gridironing, and (C) a combination of the two

whereby the major sample is obtained by the strip or gridiron method but is augmented by additional sampling where needed within specific types. A fourth procedure of sampling, whereby a so-called "typical" area is selected and sampled as being representative of a larger surrounding area, is not recommended because a reliable average is not always obtained and because such data may not be applicable to the development of management plans.

Procedure A should be used under condition 1 described above. It consists of first determining the location and extent of the type; secondly, of an estimation of the approximate acreage and the number of plots necessary to sample the type. The center of the first plot should be determined at random by throwing a stone into the type. The estimator ordinarily should proceed along the longitudinal axis of the type estimating plots at a pre-determined sampling interval until the necessary number of plots has been completed. All of the series should be well within the type boundaries. The minimum number of plots to sample various acreages is as follows:

10 - 20 acres	3 plots
20 - 80 acres	5 plots
80 - 640 acres	10 plots

It is not contended that 3 plots will give an adequate sample of a small type from a statistical viewpoint. However, in any management unit, the same type may occur many times. Therefore, it is believed that with the minimum per-acre set up, a dependable estimate of plant cover may be obtained.

Procedure B should be used under conditions 2, 3, 4, and 5. It consists of a uniform spacing of plots on a line or lines within a section,, township or other arbitrarily bounded area. It may also be used within a definite topographic unit if conditions 2, 3, 4, or 5 are present. If the minimum sample is to be used, one line of 10 plots spaced at 8 chain intervals through the middle of each section is preferable. If greater intensity is desired in the survey two parallel lines of 10 plots each one half mile apart may be used. If still greater intensity is desired, 25, 36, etc., equidistant plots within the section necessitating 5, 6, etc., lines through each section should be used. In either the strip or grid system the type lines are indicated when crossed by or seen from the survey line and the estimated plots are segregated both according to the type in which they fall and by the section being surveyed. The estimator should leave his line of plots whenever necessary to close a type boundary or to indicate its extension to the next line of survey.

Procedure C should be used when condition number 6 exists. This procedure is a combination of A and B, and consists of sampling the large low value type in a similar manner and with the minimum requirements stated under procedure B, and digressing from the survey line to sample the small important types as outlined in procedure A.

With the foregoing suggestions as a guide it is left to the discretion of the chief of party to use the three procedures in a manner best suited to meet local needs and conditions. If, for example, rugged topography makes procedure B exceedingly laborious, procedure A may be used.

Supplemental Instructions

1. Reconstruction of vegetation: The density of vegetation should be based on the spread of the plants as they would appear when they have attained their full growth in a normal year in an ungrazed condition.

2. Elimination of unimportant species: Nonpoisonous species of zero palatability when not important from a soil-conservation standpoint may be omitted from the density estimate, unless a full plant inventory is desired.

3. Minimum limit of estimation: In general, densities should not be counted that will not make 1/2 square foot unless in sparse vegetation it seems advisable to reduce the limit of estimation to 1/4 square foot. If a complete record of plant occurrence is desired, species present on the plot but not abundant enough to reach the lower limit of density should be recorded as a trace (T).

4. If species unimportant to grazing and individually not estimated are present, an estimate of total plant cover may be made if desired for erosion studies.

5. In addition to the forage inventory, the examiner should make field notes by types or topographic units which will enable him to prepare the unit descriptions called for on page 9 of these instructions.

Field Computation:

In the determination of the forage factor, the following order of computation should be observed:

1. Add the species densities for each plot and record the total estimated density in the space provided on the field sheet (764b).

2. Add the densities for each species horizontally across the form for all plots within the type and record the sums in the total density column.

3. Add the total densities of species. This sum should equal the total of the plot densities.

4. Divide each total species density by the number of plots in the type and record the quotients in the average density column.

5. Sum the average densities. This sum should equal the average total density.

6. Multiply the average density of each species by its percentage palatability.

7. Add the products thus obtained to secure the forage factor. This is expressed as forage acres per hundred surface acres and two decimal places should be pointed off to the left to obtain values expressed in terms of one surface acre.

GRAZING CAPACITY COMPUTATIONS (EITHER METHOD)

Forage Acre Requirement

Determination of the forage acre requirement base by means of which the forage acre data are converted to terms of grazing capacity is as important as any phase of the range survey work.

Ordinarily the most satisfactory method of determining this base is to select for forage acre requirement studies those allotments, pastures or ranges that have every appearance of having been properly used for a period of years and that have been surveyed in the course of the season's work. These areas should be as representative of large portions of the range as it is possible to find. Figures for controlled ranges, whenever obtainable, should be used. At the close of the season the chief of party will make utilization and range condition studies of these ranges and will obtain the most accurate and detailed information possible on the rate of stocking and seasonal use that has obtained on such areas for the past several years. Supplied with this information he is able to determine, as soon as compilation of the current survey data is complete, the number of forage acres per animal unit that have been used in the past following up this determination with slight adjustments to correlate actual use with previously determined range conditions on the selected areas should yield a satisfactory base from which to determine approximate grazing capacity. Preferably these figures should be based on a slightly below indicated requirement pending actual trial of the recommended stocking. If actual use on the basis of recommended stocking indicates that the forage acre requirement determined is uniformly high or low, it should be adjusted to permit increased or reduced stocking.

When the forage acre requirement proves unsatisfactory under general application, owing to important differences in forage composition or range conditions, there should be no hesitation in making additional studies to determine the appropriate requirement for different localities. There is a distinct danger in applying a predetermined forage acre requirement to a new project or to a new series of types without determining, first, that the two ranges are similar in the main characteristics, and, second, that the bases for estimating density, composition, palatability and utilization

are directly comparable. In the absence of these requisites a new test to determine the requirement should be made.

The forage acre has erroneously been accepted as a constant. Actually it is a variable. This is evident because of the continual need of applying different forage acre requirements to obtain grazing capacity in different localities or in the same locality with different methods of estimation. Consequently, the forage acre has been misleading to stockmen, to economists who have attempted to capitalize it, and to agencies who attempted to correlate grazing capacity on different ranges.

In the future, forage acres will be omitted on all range maps and Graphic plans and grazing capacity in terms of animal months substituted therefor. This will bring all maps and plans to the same basis.

To compute the grazing capacity, multiply the surface acreage of a type by its forage factor, and divide the result by the proper forage acre requirement. The forage acre requirement may be in terms of sheep or cow months, or years. Grazing capacity is, therefore, expressed in sheep or cow months, or years, according to the forage acre requirement used.

Thus, the final maps will always show for each type the following:

Surface acreage
Grazing capacity (in sheep or cow months or years)

Other converting factors or pertinent information may be added if desired.

ESTIMATING GRAZING CAPACITY OF ANNUALS

In judging the value of ranges where the production of "annuals" importantly affects the grazing capacity it is first of all essential that sound range management objectives be clearly defined for the area or region. For example: Depleted ranges producing dependable crops of annuals may be managed with a view to getting fullest possible use of the annuals from a live stock economy standpoint or to making but very moderate use of the "annuals" from a broader viewpoint of eventually restoring the former perennial plant composition and density.

As a general rule it is assumed that the objective will be to hasten recovery of the valuable perennial species. In such cases the value of annuals should be kept sufficiently low to allow for their extreme fluctuations with relation to climate and to insure against overutilization of associated perennials. At the discretion of the administrative agency, the density of annuals may be ignored in the type writeup and their value

calculated in other terms such as a direct estimate of safe grazing capacity based on the actual season of dependable use.

In unusual cases, where natural revegetation is out of the question, annuals may be considered under the same surveys procedure as for perennials but conservative forage acre requirement ratings should be assigned to compensate for extreme fluctuation in forage production and to provide a safety factor in soil conservation.

Progress Report

At the end of the field season, the chief of party will prepare a progress report of the work done during the season. This report will include the following: Acreage and part of unit covered, organization and qualifications of the crew, training given men in the field, methods used, recommendations for future work, and a statement of costs. The cost report will show in detail the various expenditures -- total cost of various operations in the field; cost per acre of surveying, field examination, office, herbarium, moving, noneffective days other than moving; average cost per acre; and average acreage covered in the field per day.

CLASSIFICATION OF FORAGE TYPES

Type designations

Types will be indicated by the proper type number followed by standard symbols to indicate the dominant species. Types containing a timber overstory will carry the principal timber species symbol after the type numbers. The governing rule should be that the number and symbols will give an accurate picture of the principal species.

Types will be designated according to aspect. For instance, if the type is predominantly a grass type with scattering timber, it will be shown as a 1 type, followed by the timber symbol. The conspicuous or most important species or genus symbol will be shown first, followed by minor species. Ordinarily, unless exceptional conditions prevail not more than three symbols will be shown in a designation. If less than three species are prominent the number of symbols should be reduced accordingly.

Symbols

Symbol lists for trees, shrubs, and herbaceous vegetation should be devised and standardized for regions. Standardization of symbols for all common and widely distributed genera and species should preferably be standardized for the entire range area.

The governing principle will be a three letter symbol; all capitals for the genus symbol and one capital and two lower-case letters for species.

The genus symbol should, except for trees, consist of the first three letters of the genus name. In case of conflict the least common genus will carry the second or third letter changed to remove the conflict.

Species symbols will consist of the first letter of the Latin generic name, followed by the first two letters of the specific name. In case of conflicts, the same rule will be applied as for removing conflicts in genus symbols. Where the species determination is unimportant and where the species cannot be readily identified the genus symbol may be used. When there is a difference in forage value or general characteristics between species in the same genus, the species symbol should always be used.

Color Legend:

Standard colors are shown for each type by crayon numbers.

The use of crayons contemplates a medium - light application of crayon, smoothed out through the use of a stomp dipped in gasoline.

Type Descriptions

Type No.	Standard(Mongol Color crayon guides)	
		Grassland
1. (S)	Short grass Light yellow Mongol - 817	Includes grassland other than meadow and secondary meadow. Perennial grasses predominate and determine the aspect, although weeds and browse may be present.
1. (T)	Tall grass Dark yellow Mongol - 867	Examples of types are: grama-buffalo grass, bunch grass, wheatgrass-sedge, alpine grassland, blue stem.
		Meadow
2.	Cadmium Orange (Mongol 862).	Includes areas where sedges, rushes, and moisture-enduring grasses predominate, Two classes of meadows are recognized: wet meadows and dry meadows. Wet meadows are characterized principally by sedges and remain wet or moist throughout the summer. These shall be designated as 2W-Wet Meadow or Marsh. Dry meadows are dominated by grasses rather than sedges and occur as moist meadowlike areas in open timber or intermittent meadow, both of which become moderately dry by mid-summer. These shall be designated as 2-D Dry Meadow or Flood Plain.

Perennial forbs (Weeds)
(Not desert weeds)

3. Lake Red
Mongol - 866

Includes all untimbered areas where perennial weeds predominate over other classes of vegetation. There is very little true weed type, as a weed cover is usually more or less temporary in character and is soon replaced by a more permanent type if the disturbing factor is removed. If there is no great predominance of the weeds over the grass or brush vegetation, and if it is possible to judge that the weed predominance is due to some unnatural factor, the weeds should be disregarded in designating the type and the more stable vegetation should be used as an index. The weeds will then be cared for in the sub-type.

Sagebrush

4. Stone Brown
Mongol - 893

This type includes all untimbered lands where sagebrush or shrubby species of similar appearance predominate. The sagebrush lands are usually of different range values and different in season of grazing from the areas which are listed below under browse. Areas dominated by shrubby species of sagebrush, including big sagebrush (Artemisia tridentate shall be classed as sub-types, as for example Artemisia filifolia, A. cana, and A. tripartita. Other shrubby species such as Chrysothamnus should be designated as sub-types when they become dominant in sagebrush areas.

This and the browse type which follows are sometimes difficult to distinguish from the grass and weed types if aspect rather than the dominant class of forage is used as the distinguishing characteristic. Sagebrush may form only 15 percent of the total vegetation of a type and still its aspect may be that of a sagebrush type.

It may prove desirable, in a given region, to decide on a certain percentage of all the vegetation in the type, say 20 percent, as the minimum proportion of sagebrush that may be present if the area is still to be classified as a 4 type, providing, of course, it does not already have the aspect of some other type. The same will hold true of the browse type.

Browse-Shrub

5. Olive Green Mongol - 888

This type includes all untimbered lands where browse, except sagebrush or its sub-types, gives the main aspect to the type or is the predominant vegetation. Characteristically it occupies the transition zone of the lower mountain slopes, foothill, and plateau areas. Examples of sub-types are mountain mahogany, bitter brush, willows, Ceanothus-Manzanita, California Chaparral, etc.

Conifer

6. Dark Green Mongol - 858

This type includes all range in coniferous timber supporting grasses, weeds, browse, either singly or in combination, except as provided under Type 7 and 9. The forage may vary from a pure stand of pine grass, or some other grass, to a pure stand of weeds or browse. It usually, however, consists of grasses, weeds, and browse, and the proportion of each species varies so widely that it is not thought advisable to attempt a division into types with distinct colors. These variations can best be represented by sub-types,

Waste

7. Blue Green Mongol - 898

This type includes all areas of dense timber and brush which have no value for grazing or have such slight value that they cannot be used economically, owing either to denseness of standing or down timber or sparseness of forage growth. Large areas of very sparse forage, unless within easy reach of a better type, shall be classified as waste because of the impracticability of running stock over so large an area to get such a small amount of feed.

This type also includes other waste areas not strictly in timber or brush and not barren which are so rough or inaccessible as to make their future use improbable.

The sub-type designations generally encountered in this type are as follows: 7T- Waste in Dense Timber; 7D waste in Down Timber; 7B - Waste in Brush; 7R - Waste Areas where Rocky Character Prevents Use; and 7I - Permanently Inaccessible Areas. Principal species of timber should be shown by symbols.

Barren

8. (blank)

This type includes all areas on which there is naturally no vegetation, or practically none, including intermittent lake beds, saline flats, active sand dunes, shale, rock slides, lava flows, etc. Areas which have been denuded by overgrazing should not be confused with areas naturally barren, nor should areas containing only annuals for a part of the year be shown under 8, although these may be without vegetation for the remainder of the year.

Pinon-Juniper

9. Light Green
Mongol - 848

This type includes pinon, Juniper, pinon-Juniper, and digger pine. The character of the range in this type as regards location, grazing capacity, and management is sufficiently distinct from the conifer type to justify a separate color. The forage may vary from a pure stand of grasses, weeds, or browse to a combination of any two or all. This variation can best be shown by sub-type designations.

Broad Leaf Trees

10. Pink
Mongol - 846

This type includes all range in deciduous timber. The combination of grasses, weeds, and browse, and the proportion of individual species, will vary as in other types.

The principal sub-types which will be encountered are: aspen, cottonwood, oak, birch, alder, ash-elm, etc., when they occur in tree form.

Creosote

11. Bottle Green
Mongol - 855

This type includes areas where creosote bush (Covillea) constitutes the predominant vegetation.

Mesquite

12. Yellow Earth
Mongol - 853

This type includes areas where various species of the Mesquite (Prosopis) give the characteristic aspect or constitute the predominant vegetation.

Saltbush

13. Slate
Mongol - 819

This type includes areas where the various salt desert shrubs of the Atriplex family form the predominant vegetation, or give the characteristic aspect. There is sufficient significant difference in the range value and the use of saltbush areas to justify their separation from other desert or semi-desert shrub types.

Greasewood

14. Royal Purple
Mongol - 864

This type includes areas where greasewood (Sarcobatus) is the predominant vegetation or gives a characteristic aspect. Characteristically this type occupies valley floors subject to overflow during flood periods or areas underlain with ground-water at shallow depths where the soil is more or less saline. It is sufficiently differentiated from other desert shrubs to justify an exclusive type.

Winterfat

15. Light Tan
Mongol - 813

This type includes areas where winterfat (Eurotia) gives a characteristic aspect or constitutes the predominant vegetation. Though commonly associated with other semidesert shrubs, the occurrence of this plant in Utah and Nevada as a type character is of sufficient extent to justify a separate type.

Desert Shrub

16. Dark Tan
Mongol - 863

This is a general type which includes areas where other desert shrubs aside from those separated into individual types, constitute the predominant vegetation or give the characteristic aspect. This type includes several genera which are quite distinctive in type habit such as black brush (Coleogyne), coffee berry (Simmondsia), Catclaw (Acadia, Mimosa), gray molly (Kochia), hopsage (Grayia spinosa), spiny horsebrush (Tetradymia spinescens), and little rabbitbrush (Chrysothamnus stenophyllus) but pure types of each are so limited in extent as to not justify separate type. The plant symbols used will be sufficient to indicate the predominant species present.

Half Shrub

17. Wisteria
Mongol - 844

This type includes areas where half shrubs constitute the dominant vegetation or give the characteristic aspect.

Half shrubs are semi-woody perennials of low stature such as Aplopappus, Gutierrezia, Artemisia frigida, Eriogonum wrightii, etc. They commonly consist of a woody caudex from which herbaceous stems are produced that die back annually. These genera are sufficiently distinctive in habitat and of wide enough extent in certain localities to justify a separate type designation.

Annuals (Weeds or Grasses)

18. Red Terre Cotta

This type includes areas in which annual weeds or annual grasses constitute the dominant vegetation. Both transitory stages and semi-permanent conditions should be included in this type as for example: Russian thistle, downy chess (Bromus tectorum) desert weeds. The plant symbols used will be sufficient to indicate the predominant species present.

Abandoned Lands

Abandoned lands should be classified according to aspect. In mapping, the boundaries should be hatchered.